

What is claimed is:

1. A method of increasing an acceleration rate of a combustion engine during combustion engine acceleration, the combustion engine including a crankshaft, the method comprising:

providing an electromagnetic motor/generator in rotating combination with the crankshaft, the electromagnetic motor/generator adapted to rotate the crankshaft upon receiving an electrical current from a battery system;

determining an acceleration demand of the combustion engine;

powering the electromagnetic motor/generator with the electrical current, wherein the electrical current is proportional to the acceleration demand; and

increasing the rotational speed of the crankshaft by the electromagnetic motor/generator;

wherein increasing the rotational speed of the crankshaft by the electromagnetic motor/generator increases the acceleration rate of the combustion engine.

2. The method according to Claim 1, wherein the electrical current has a power of about 5 kilowatts.

3. The method according to Claim 2, wherein the battery system is a 42 volt battery system.

4. The method according to Claim 1, additionally comprising determining an acceleration demand of the combustion engine at the crankshaft.

5. The method according to Claim 1, additionally comprising determining an acceleration demand of the combustion engine from a parameter selected from a group including crankshaft acceleration rate, engine friction, non-linear hydrodynamic forces, combustion engine temperature, electromagnetic motor/generator temperature, battery charge, electrical load demand, and combinations thereof.

6. The method according to Claim 5, additionally comprising determining the parameter using at least one of transducers and estimation techniques.

7. The method according to Claim 6, wherein the acceleration demand is determined mathematically using at least one parameter.

8. The method according to Claim 3, wherein while the combustion engine is operating and not accelerating, the electromagnetic motor/generator generates an electrical current and charges the battery system.

9. The method according to Claim 8, wherein the crankshaft powers the electromagnetic motor/generator to recharge the battery system.

10. The method of Claim 1, wherein the electromagnetic motor/generator comprises:

a disc-shaped rotor connected to the crankshaft; and

a stator disposed at least partially around the rotor and fixedly connected to an engine body of the combustion engine;

wherein the rotor rotates within the stator.

11. The method of Claim 1, wherein the electromagnetic motor/generator comprises:

a rotor connected to the crankshaft; and

a disc-shaped stator fixedly connected to an engine body of the combustion engine;

wherein the rotor rotates external to the stator.

12. A method of operating a vehicle including a combustion engine, a transmission, an electromagnetic motor/generator, and a control system, the combustion engine having a crankshaft connected to the transmission, the electromagnetic motor/generator in rotational combination with the crankshaft and connected to a battery system, and the control system in controlling combination with the electromagnetic motor/generator, wherein the electromagnetic motor/generator is adapted to function at times as a power source adding torque to rotate the crankshaft and at other times to function as a power generator for subtracting torque from the crankshaft to provide electrical current to the battery system, the method comprising:

determining an acceleration demand of the combustion engine during engine acceleration;

directing with the control system a first electrical current from the battery system to the electromagnetic motor/generator during combustion engine acceleration, wherein the first electrical current is proportional to the acceleration demand;

powering the electromagnetic motor/generator with the first electrical current during acceleration of the combustion engine to add torque to the crankshaft;

determining one of a low electrical charge of the battery system and a high vehicle electrical operating load;

powering the electromagnetic motor/generator with the crankshaft to produce a second electrical current; and

directing with the control system the second electrical current to the battery system, wherein the second electrical current charges the battery system.

13. The method according to Claim 12, wherein the battery system is a 42 volt battery system.

14. The method according to Claim 13, wherein the first electrical current has a power of about 5 kilowatts.

15. The method according to Claim 12, additionally comprising determining an acceleration demand of the combustion engine from a parameter selected from a group including crankshaft acceleration rate, engine friction, non-linear hydrodynamic forces, combustion engine temperature, electromagnetic motor/generator temperature, battery charge, electrical load demand of the vehicle, and combinations thereof.

16. The method according to Claim 15, additionally comprising determining the parameter using at least one of transducers and estimation techniques.

17. The method according to Claim 16, wherein the acceleration demand is determined mathematically using at least one parameter.

18. The method according to Claim 12, wherein the electromagnetic motor/generator produces the second electrical current while the combustion engine is operating and not accelerating.

19. The method of Claim 12, wherein the electromagnetic motor/generator comprises:

a disc-shaped rotor connected to the crankshaft; and

a stator disposed at least partially around the rotor and fixedly connected to an engine body of the combustion engine;

wherein the rotor rotates within the stator.

20. The method of Claim 12, wherein the electromagnetic motor/generator comprises:

a rotor connected to the crankshaft; and

a disc-shaped stator fixedly connected to an engine body of the combustion engine;

wherein the rotor rotates external to the stator.